ANTHROPOMETRIC, PHYSIOLOGICAL AND PERFORMANCE CHARACTERISTICS OF SUB-ELITE NIGERIAN BADMINTON PLAYERS

O. O. AKINBIOLA, S. A. ADENIRAN and C. F. AKINNUBI
Department of Physical & Health Education,
Obafemi Awolowo University, Ile-Ife Nigeria.
oluwabusayoakinbiola@gmail.com

Abstract

The purpose of this study was to determine the anthropometric, physiological and performance profiles of sub-elite Nigerian badminton players and to find out if differences exist between the male and female players. The descriptive survey design was used in the study. Twenty two Obafemi Awolowo University badminton athletes (14 male and 8 female) were selected for the study. The procedure of the International Society for the Advancement of Kinanthropometry (ISAK) was used in all anthropometric measurements. T-Test statistics was used in the analysis of data. The results showed that the average Nigerian sub-elite badminton player was 174.1 ± 6.92 cm tall, weighed 67.37 ± 6.56 kg, had a BMI of 22.3 ± 2.21, Σ7 skinfolds of 52.98 ± 13.7 mm and % body fat of 9.18 ± 4.56. Also, a sub-elite Nigerian badminton player had an estimated VO_2 max of 49.84 ± 3.37 ml. kg^{-1} min^{-1}. The average values for flexibility, jump height and hand grip strength were 11.59 ± 4.93 cm, 22.43 ± 7.53 cm and 41. 98 ± 7.92 kg respectively. Acceleration, speed and sprint performance were, 1.52 ± 0.20 sec, 2.36 ± 0.48 sec and 3.91 ± 0.59 sec respectively. Male and female badminton players differed significantly in height ($t = 2.08$; $p < 0.05$), humeral diameter ($t = 2.29$; $p < 0.05$), arm circumference ($t = 2.63$; $p < 0.05$), thigh girth ($t = 2.19$; $p < 0.05$), calf girth ($t = 4.45$; $p < 0.05$), Σ7 skinfolds ($t = -6.28$; $p < 0.05$) and % body fat ($t = -15.08$; $p < 0.05$). Male and female badminton players were however not different in weight ($t = 1.62$; $p > 0.05$). Male badminton players differed significantly from their female counterparts in estimated VO_2 max ($t = 5.35$; $p > 0.05$) and heart rate ($t = -5.06$; $p > 0.05$). The results also showed that male and female badminton players differed significantly in flexibility ($t = -10.95$; $p < 0.05$), vertical jump ($t = 24.88$; $p < 0.05$), hand-grip ($t = 7.92$; $p < 0.05$), acceleration ($t = -5.66$; $p < 0.05$), Speed ($t = -6.79$; $p < 0.05$) and sprint time ($t = -10.99$; $p < 0.05$). The results further showed that sub-elite badminton players differed in only three anthropometric parameters (height, $t = 13.01$; $p < 0.05$, weight, $t = 2.63$; $p < 0.05$ and BMI, $t = 3.39$; $p < 0.05$) but did not differ significantly in other three (Σ7 Skinfolds, $t = .37$; $p > 0.05$, % body fat, $t = .19$; $p > 0.05$ and body density, $t = .41$; $p > 0.05$).

The study concluded that the badminton players could be classified as being at the elite level when values got were compared with international standards.

Key Words

Anthropometry, Physiological, Elite-Athlete, Badminton

Introduction

The identification of physical parameters characteristic of a sport enables coaches and athletes to design and apply suitable conditioning programmes, which contribute to player's improved performance. Such parameters could be used to differentiate athletes in different sports. Descriptions, such as anthropometry, muscle fibre types and physiological characteristics have been explored in attempts to describe and differentiate athletes in various sports, as well as those playing different roles within the same sport (Adeniran, Toriola and Amusa, 2010). These descriptions are of great interest to sports coaches and scientists (Campos, Angioluci, Larissa, Mastrascusa, Dourado and Luiz, 2009). The relationship between morphological variables and sports performance is the object of study of anthropometry and is an important element to be analyzed (Campos et al, 2009).

The interest in anthropometric characteristics, body composition and somatotype from different competitive sports, has increased over the last decades (Cristobal, Sanz and Zabala, 2007). A lot of studies on physique of athletes have been conducted, anthropometric investigations on elite athletes have been carried out at Olympic games (McMillan, Helgerude, Macdonald & Hoff, 2005) and on specific sports, such as swimming (Carter and Ackland, 1994), soccer (Rienzi, Drust, Reilly, Carter and Martin, 2000), gymnastics (Classens, Veer, Lefevre, Maes, Steens and Beunen, 1991), rowing (Claessens, Bourgois and Vrijens, 2001) and basketball (McInnes, Carlson, Jones and McKenna, 1995). However, few studies have investigated anthropometric

and performance characteristics in badminton players (Faude, Meyer, Rosenberger, Fries, Huber and Kindermann, 2007).

Badminton is a racquet sport played in singles and doubles, with some aspects of its rules similar to tennis. Players stand on opposite sides of a court to hit a shuttlecock over the net and unto the floor within the court boundaries to win a point. The game is commenced with an underarm service by one of the players standing on the right side, hitting the shuttlecock over the net to land in the diagonal half of the opposite court. Under the new 21 points scoring system, a player or pair wins a game by attaining the score of 21, and ahead of the opponent/s with two points. The game is characterized by fast pace intermittent exercise. The demand of training and game play in elite badminton is predominantly aerobic (Majumder, Khana, Malik, Sachdeva, Arif and Mandal, 1997). Faude et al. (2007) described badminton as a sport which requires both aerobic and anaerobic energy systems, comprising both short and long rallies. However, it is highly that the prevailing energy source in a rally is the alactic anaerobic metabolism.

Several factors, including technique and tactics, psychological preparation and game strategy, contribute to success in badminton (Jeyaraman and Kalidasan, 2012; Seth, 2016). In addition to game skills, badminton athletes must possess great physical capacity, especially speed and aerobic strength and power. Various studies on fitness development in badminton concur with the notion that badminton players should incorporate flexibility, strength, and endurance training in their programmes to reduce fatigue and muscular injuries, while simultaneously improving performance (Majumder et al 1997, Campos et al 2009, Cabello and Gonzalez 2003).

Although Nigeria has achieved some measure of success and fame in badminton within Africa and its regions, few studies have focused on assessing the characteristics of successful elite or

sub-elite badminton players. The objective of this study was to identify the anthropometric, physiological and performance characteristics of male and female sub-elite badminton players.

Methods

Subjects

The sample comprised 22 badminton players (14 male and 8 female) on the Obafemi Awolowo University badminton team. Before undergoing the test, all the participants were duly informed of the testing procedures and were sensitized on possible risks involved. They also gave informed written consent.

Data Collection

Data were collected during the two weeks of camping for the preliminaries of the 24th NUGA held at Obafemi Awolowo University, Ile-Ife Nigeria. Each participant's height was measured with a height meter to the nearest 1mm. Body weight was measured using a calibrated electronic weighing scale (Hanson Digitech. 20665) to the nearest 100g. Circumferences were measured with a flexible non- extensible fiber tape to the nearest 1mm. Humeral and femoral breadths were measured with a sliding caliper to the nearest 0.01 cm. Skinfolds were measured with Lange skinfold caliper (PAT. NO. 3.008.239, Cambridge Scientific Industries, Cambridge Maryland).

Anthropometric Variables

Participants were measured for anthropometric variables: body weight, height, bone diameters (humeral and femoral), body circumferences (relaxed arm, contracted arm, thigh and calf girths) and skinfold thickness measured at seven sites (Triceps, Subscapular, Biceps, Supraspinale,

Abdominal, Front- thigh and Medial calf). The protocol of the International Society for the Advancement of Kinanthropometry (ISAK) was used. All measurements were taken at the right side of participant's body to ensure uniformity. Measurements were taken three times and where there was disparity in readings, the average of three measurements was used.

Performance Tests

The sit-up test (also known as curl-up test) was used to measure abdominal muscle endurance. The number of repetitions made in 30 seconds was recorded for the participant. Handgrip strength test was administered on participants to measure the maximum isometric strength of the hand and forearm muscles. The participant gripped the handle of the dynamometer keeping arm at right angle to the side of the body. The dynamometer was squeezed with maximum isometric effort, which was sustained for 5 to 10 seconds. The best score from 3 trials was recorded for each participant.

Players speed was assessed using the 20-meter sprint test with timing gates placed at 0-5 meters, 10-meters and 20-meters. The best test result out of three attempts with a 10-minute interval was recorded for each participant. The Vertical Jump test was administered to determine the maximal jumping ability of participants and to assess their lower body power. Participants crouched from a standing position and then immediately jumped maximally alongside a wall. Arm swing was allowed to aid in jump performance and legs were kept straight while in the air. Two trials were performed with a minimum of 2 minutes rest between trials. The better effort was recorded.

Aerobic Power

Aerobic power was assessed using the Cooper 12- min Run/walk test. The test was carried out on a standard 400 meter athletics track in line with the protocol prescribed for the test. Participants

were advised to pace rather than walk or run at full speed and to maintain the pacing till the end of the test period. The total distance covered in 12 minutes was recorded for individual participant. Also, subjects were verbally motivated and encouraged throughout the duration of this test.

Statistical Analysis

Statistical analysis was performed using the 'Statistical Packages for Social Sciences' (SPSS) software, version 16.0. Descriptive statistics of mean and standard deviations were computed. Student's t test was used to find out where statistically significant differences existed between male and female participants.

Results and Discussion

Anthropometric, performance and physiological characteristics of the badminton athletes engaged in the study are presented in Tables 1to3, while tables 4, 5 and 6 present summaries of T-test statistic.

Table 1: Anthropometric characteristics of Male and Female Nigerian Sub-Elite Badminton Players

	Male (n = 14) ($\bar{x}$ ± SD)	**Female (n = 8)** ($\bar{x}$ ± SD)
Age (Years)	27.86 ± 1.95	23.63 ± 2.93
Weight (Kg)	69.01 ± 7.66	64.49 ± 2.30
Height (cm)	176.28 ± 7.13	170.36 ± 4.89
Humeral (mm)	15.40 ± .84	14.47 ± 1.04
Arm girth (cm)	3.21 ± .29	2.90 ± .23
Thigh girth (cm)	5.13 ± .16	4.96 ± .19
Calf girth (cm)	3.56 ± .13	3.30 ± .12
Σ7- Skinfolds (mm)	44.74 ± 8.74	67.40 ± 7.04
% Fat	5.95 ± 1.39	14.84 ± 1.20
BMI	22.36 ± 2.65	22.50 ± 1.28

Table 2: Performance characteristics of Male and Female Nigerian Sub- Elite Badminton Players

Variables	Male (n = 14) ($\bar{x}$ ± SD)	Female (n = 8) ($\bar{x}$ ± SD)
Flexibility (cm)	8.21 ± 2.15	17.45 ± 1.36
Hand Grip Strength (kg)	47.07 ± 4.66	33.06 ± 2.29
Acceleration km/hr^2	1.41 ± .15	1.72 ± .07
Speed km/hr	2.07 ± .28	2.88 ± .25
Sprint km/hr	3.51 ± .24	4.61 ± .19
Vertical Jump (cm)	27.90 ± 1.38	12.85 ± 1.34

Table 3: Physiological characteristics of Male and Female Nigerian Sub- elite Badminton Players

Variables	Male (n = 14) ($\bar{x}$ ± SD)	Female (n = 8) ($\bar{x}$ ± SD)
VO_2 Max (ml/kg/min)	51.75 ± 2.52	46.50 ± 1.49
Heart Rate (beats/min)	112.86 ± 14.73	141.50 ± 7.98

Table 4: t- test summary table for the Anthropometric characteristics of male and female Sub-Elite Badminton players.

	F	Sig	T	Df	Sig. (2tailed)
Weight (kg)	4.450	.048	1.615	20	.122
Height (cm)	1.057	.316	2.074	20	.051*
Humeral Dia. (mm)	.599	.448	2.296	20	.033*
Arm Circ. (cm)	.745	.398	2.627	20	.016*
Thigh Girth (cm)	.365	.553	2.187	20	.014*
Calf Girth (cm)	.291	.596	4.448	20	.000*
Σ7 Skinfolds	.638	.434	-6.274	20	.000*
% Body Fat	.448	.511	-15.078	20	.000*
BMI	.899	.354	.107	20	.916

Note: * Significant at p < 0.05

Table 5: T- test summary table for the Performance characteristics of male and female Sub-elite Badminton players

	F	Sig	T	Df	Sig. (2tailed)
Flexibility (cm)	3.313	0.84	-10.950	20	0.00*
Hand-Grip (kg)	1.967	.176	7.919	20	0.00*
Acceleration (km/hr^2)	1.096	.308	-5.655	20	0.00*
Speed km/hr)	.004	.949	-6.788	20	0.00*
Sprint (km/hr)	.023	.881	-10.999	20	0.00*
Vertical Jump (cm)	.070	.795	24.872	20	0.00*

Note: * Significant at p < 0.05

Table 6: T- test summary table of the Physiological characteristics of male and female Sub-elite Badminton players

	F	Sig	T	Df	Sig. (2tailed)
VO_2 Max (ml/kg/min)	2.724	.114	5.345	20	0.00*

Heart Rate (beats/min)	.815	.377	-5.056	20	0.00*

Note: * Significant at p < 0.05

Table 1 and the corresponding t-statistics (Table 4) showed that males and females did not differ from each other in weight and BMI. Males were taller and had significantly higher humeral, arm and thigh and calf diameters. The females had a significantly higher sum of seven skinfold values and thus higher values of percent fat. Data on Junior South African badminton players showed that for males, height was 180.4 ± 8.1 cm, body mass was 73.4 ± 9.7 kg and percent body fat was 9.6 ± 1.6 %. For females, these were 58 ± 7.9 cm, 161 ± 4.3 kg and 19.2 ± 4.5 %. These values are comparable to those of the current study.

Table 2 and the corresponding t-statistics (Table 5) showed that males were significantly stronger in grip strength, faster in speed, acceleration and sprint run and were better in the vertical jump test. The females were however more flexible than the males. The findings of the current study on performance characteristics is similar to that of Abdullahi, Toriola, Goon, Paul, Igbokwe and Suarau (2017) who reported that male badminton players had superior anthropometric and motor fitness than their female counterparts, but the females were superior in flexibility.

Table 3 and the corresponding t-statistics (Table 6) showed that males were better in oxygen consumption (VO_2max) and heart rate. An athlete's VO_2 max is important as it theoretically sets the upper limit on endurance performance. Female athletes are said to have lesser VO_2 max (Plowman and Smith, 1997; Maud and Forster, 1995) due to higher body fat content, smaller muscle mass and lower hemoglobin content (Noakes, 1996). The female blood consists of 13g of

hemoglobin per 100 ml of blood while the male consists of 15g (Omosegaard, 1996). VO_2 max of top badminton players range between 55.7 and 73.0 ml. kg^{-1} min^{-1} (Omosegaard, 1996; Chin et al, 1995).

Though the estimated VO_2 max of badminton players in the current study was lower than that of top elite badminton players, their values in anthropometric and performance characteristics were comparable with the elite players. The study concluded that the University badminton players could be classified as being at the elite level as their values could compare with international standards.

References

Adeniran, S.A, Amusa, L.O. & Toriola, A.L. (2010). Effects of continuous and interval running programs on aerobic and anaerobic capacities in schoolgirls aged 13 to 17 years. *Journal of Sports Medicine.* **28**(3), 260-266.

Cabello M. D. & González-Badillo, J. (2003). Analysis of the characteristics of competitive badminton. Br J Sports Med v. 37, p. 62–66.

Campos, F.A.D, Daros, L.B, Mastrascusa, V, Dourado, A.C, & Stanganelli, Luiz, C.R. (2009). Anthropometric profile and motor performance of junior badminton players. Brazilian Journal of Biomotricity, **3**, n. 2, p. 146-151.

Carter, J. E. L., & Ackland, T. R. (1994). Kinanthropometry in Aquatic Sports. Champaign, IL: Human Kinetics, Chapter 4, 55-82.

Claessens A. L., Bourgois J., Lefevre B., Van Renterghem B., Philippaerts R., Loos R., Janssens M., Thomis M. and Vrijens, J. (2001). Body composition and somatotype characteristics of elite male junior rowers in relation to competition level, rowing style and boat type. Journal of Sports Sciences; **19**(8): 611 Abstract.

Claessens A.L, Veer, F.M, Lefevre, J, Maes, H, Steens, G. & Beunen, G (1991) Anthropometric characteristics of outstanding male and female gymnasts. Journal of Sports Sciences, **9**, 53-74.

Cristobal, S.M, David, S & Zabala, M. (2007). Anthropometric characteristics, body composition and somatotype of elite junior tennis players. British Journal of Sports Medicine, **41**: 793-799.

Faude, O, Meyer, T, Rosenberger, F, Fries, M, Huber, G, & Kindermann, W. (2007). Physiological characteristics of badminton match play. Eur J Appl Physiol. v. 100, 479-485.

Majumdar, P, Khanna, G, Malik, V, Sachdeva, S, Arif, M. & Mandal, M. (1997). Physiological analysis to quantify training load in Badminton. Br J Sports Med v. 31, p. 342-45.

Jeyaraman, R. and Kalidasan, R. (2012). Prediction of playing ability in badminton from selected anthropometrical physical and physiological characteristics among inter collegiate players. IJAIR

McInnes S.E, Carlson J.S, Jones C.J, McKenna M.J. (1995). The physiological load imposed on basketball players during competition. J Sports Sci. **13**: 387–397.

McMillan, K, Helgerude, J, Macdonald, J. & Hoff, J. (2005). Physiological adaptations to soccer specific endurance training in professional youth soccer players. British Journal of Sports Medicine. **39**: 273-277.

Rienzi E., Drust B., Reilly T., Carter J. & Martin A. (2000). Investigation of anthropometric and work-rate profiles of elite South American international soccer players. J. Sports Med. Phys. Fitness; **40**:162-169.

Rienzi E., Drust B., Reilly T., Carter J., Martin A. (2000). Investigation of anthropometric and work-rate profiles of elite South American international soccer players. J. Sports Med. Phys. Fitness, **40**:162-169.

Y. Abdullahi, A. L. Toriola, D. T. Goon, Y. Paul, N. U. Igbokwe and M. A. Suarau, (2017). Anthropometric and Motor Performance Characteristics of Nigerian Badminton Players. *Asian Journal of Scientific Research, 10: 244-251.*